GAIN AND LOSS OF MONEY IN A CHOICE EXPERIMENT: THE IMPACT OF FINANCIAL LOSS AVERSION AND RISK PREFERENCES ON WILLINGNESS TO PAY TO AVOID RENEWABLE ENERGY EXTERNALITIES.

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1. Introduction

Renewable energy development can cause several external impacts that need to be taken into account to achieve socially optimal decisions on placement of energy production sites. The values of such externalities are often not directly reflected in market prices. Nonmarket valuation methodology based on stated preferences (SPs) can be used to evaluate these effects and provide decision-makers with information necessary to run social cost–benefit analyses. When individuals make choices in SP studies they consider giving or receiving money in exchange for alterations in quality or quantity of a good in a hypothetical market.

In nonmarket valuation a crucial question is whether estimated values are sensitive to the direction of price changes. An increase in price can be seen as a loss of money, while a decrease in price may be considered a gain in money. If estimated values are sensitive to the direction of price changes, then the standard neoclassical framework, which assumes constant marginal utility of income changes, would not be appropriate for organizing and interpreting the results from the SP studies.

This issue has been investigated in the recent choice experiment (CE) study by Aravena et al. (2014) on the introduction of wind power as an alternative renewable energy source in Chile. The authors examine whether respondents' marginal willingness to pay (WTP) is influenced by the direction of changes in the price vector described in a CE design. They find evidence that values stated for changes in the CE attributes are unaffected by the direction of the price change. However, CE studies in other contexts, including sets of public programs, freight transport or water service, conflict with these findings, providing evidence of asymmetrical responses to price increases and decreases regarding the valued attributes (e.g., see Ozdemir, 2016; Masiero and Henscher, 2010; Lanz et al., 2010). This latter pattern of asymmetrical responses can be explained by prospect theory, which was originally proposed by Kahneman and Tversky (1979, 1991). According to this theory, the prospect of monetary gain in selling has a different (less) weight than the aversion to loss of the good. In the literature, loss aversion in the context of assigning values of nonmarket goods has been considered a putative cause of the discrepancy between WTP and willingness to accept (WTA).

Bateman et al. (2005) pose the question as to whether individuals construe money outlays (price increases) as losses or foregone gains when they relinquish money in exchange for goods. Based on the results of their experiment, Bateman et al. conclude that the WTP/WTA disparity is caused both by loss aversion regarding the good and by a perception of loss regarding paying money. In contrast, the results of Novemsky and Kahneman (2005) suggest an absence of loss aversion for money, at least in routine transactions. This latter view is supported by a neuropsychological study by Weber et al. (2007). They provide evidence that the brain regions responsible for fear perception are activated during selling but not during buying in a routine transaction, which seems to suggest loss aversion for goods as well as an absence of loss aversion for money.

In routine transactions individuals are familiar with the traded good. In many nonmarket valuation studies, however, the evaluation concerns goods or services that people are not familiar with and consequently perceive as uncertain (see e.g. Czajkowski et al., 2014, or LaRiviere et al. 2014). List (2004), for example, finds that individuals behave according to neoclassical theory for everyday consumable goods, but the pattern of his results also suggests that prospect theory adequately describes patterns of behavior among inexperienced traders.

A main objective of this study is to examine whether marginal WTP is influenced by the direction of changes in the price vector in a particular context; that is renewable energy development. We examine whether the asymmetry apparent in respondents' choices to avoid renewable energy externalities can be explained by economic drivers, such as financial loss aversion and risk preferences. This line of inquiry is meaningful because the marginal utility of income is a crucial determinant of the WTP that SP surveys are aiming for. Subsequently, the amount of externalities measured in these surveys might not only depend on the environmental changes of interest but also on factors affecting the marginal utility of income. In our survey, we combine the CE, which involves the development of renewable energies production sites (REPS) in close proximity to respondents' place of residence, with a multiple price list lottery (MPL) choice task to elicit financial loss aversion and risk preferences. Both risk preferences and loss aversion enter the estimated mixed logit model (MXL) via interaction effects, with separate variables capturing either the cost increase or the cost decrease.

In the CE we use both increases and decreases of the electricity bills to depict the uncertainty about the effect of new sources of energy generation on the current price level. Increases and decreases are presented simultaneously on the same choice tasks. Attributes and alternative labels presented in the CE describe the source and the location of energy sites andhigh-voltage transmission lines. Although the CE design does not present uncertainty over the utility gain (loss) from avoiding the renewable energy externalities directly, we assume that the respondent may be uncertain regarding the outcome.

To capture financial risk loss aversion and risk preferences, we apply a MPL with a paired lottery design introduced by Tanaka et al. (2010). This design is among the most common and frequently used experimental risk preference elicitation methods (see Binswanger, 1980 and Holt and Laury, 2002). Tanaka et al. (2010) extended the standard MPL to allow for the calculation of risk preferences parameters as well as a loss aversion parameter. This design has been applied inter alia by Nguyen and Leung (2009) and Liu (2013), who showed that people with low education are also able to understand the extended MPL.

The remainder of the paper is as follows. The next section introduces both the CE and the MPL method, and Section 3 describes the empirical survey. Section 4 contains the results of the analysis, and Section 5 discusses these results, draws some conclusions, and identifies further avenues of research.

2. Methodology

2.1. Choice experiment and econometric approach

To elicit values of avoiding renewable energy externalities we apply CE methodology. The CE is based on the consumer theory of Lancaster (1966) and assumes that any good can be described in terms of its attributes. Application of CE allows deriving a marginal rate of substitution between those attributes. The marginal rate of substitution between a nonmonetary and a monetary attribute provides a marginal WTP for the nonmonetary attribute.

The theoretical foundations for the analysis of our CE data are provided by McFadden's (1974) random utility theory. Formally, assume that the utility U derived from respondent i's choice of alternative j in choice task t can be expressed by the following:

$$U_{ijt} = X_{ijt}\beta_i + e_{ijt} \tag{1}$$

where the utility expression is separable in attribute levels X with the vector of associated parameters β, and a stochastic component e allowing for other factors than those observed by a modeler to affect individuals' choices.

To analyze data, we apply a MXL model. In the MXL model consumer i has specific, albeit nonobservable, parameters of the utility function that follow a priori specified multivariate distribution in a population $\beta_I \sim \mathbf{I}(I, \Sigma)$, where $\mathbf{I}$ is the vector of the mean values of parameters and Σ is their variance–covariance matrix. These models allow capturing the impact of choice invariant characteristics on utility. This is achieved by letting the distributions of random parameters be heterogeneous with observed respondents' characteristics (w_I). Formally, $\beta_I \sim \mathbf{I}(b + \Delta z_I, \Sigma)$, where Δ are estimable vectors of parameters that enter heterogeneous means and variances of random parameters (Greene, 2011). By assuming a structured variation of individual tastes in the sample, in the form of individual-based parameters, the MXL model is more realistic and typically yields a much better fit to the data (Greene and Hensher, 2007) than multinomial logit models in which all respondents are assumed to have exactly the same preference parameters.

In the MXL model the stochastic component of the utility function is of unknown, possibly heteroskedastic variance $\left(\mathrm{var}(e_{ijt}) = s_i^2\right)$. Identification of the model is typically assured by normalizing this variance, making the error term $\varepsilon_{ijt} = e_{ijt}/\sigma_i$, where, identically and independently, extreme value type 1 is distributed with a constant variance $\mathrm{var}(\varepsilon_{ijt}) = \pi^2/6$. This specification of the error term leads to convenient expression of choice probabilities: an individual will choose alternative j if $U_{ijt} > U_{ikt}$, for all $k \neq j$, and the probability that alternative j is chosen from a set of J alternatives becomes

$$P(j|J) = \frac{\exp(X_{ijt}\sigma_i\beta_i)}{\sum_{k=1}^{J}\exp(X_{ikt}\sigma_i\beta_i)} \quad (2)$$

In the above specification, the preference parameters became $\sigma_i\beta_i$ as a result of normalization. Due to the ordinal nature of utility (the preference parameters do not have a direct interpretation anyway), this specification still represents the same preferences for individual i.

No closed form expression of equation (2) exists when the coefficients are assumed to be random variables following the specified probability distributions. However, the expression can be simulated by averaging over D draws from the assumed distributions (Revelt and Train, 1998). As a result, the simulated log-likelihood function becomes

$$\log L = \sum_{i=1}^{N} \log \frac{1}{D} \sum_{d=1}^{D} \prod_{t=1}^{T_i} \prod_{j=1}^{J_{it}} y_{ijt} \frac{\exp\left(X_{ijt}\beta_i\right)}{\sum_{k=1}^{J_{it}} \exp\left(X_{ikt}\beta_i\right)} . \tag{3}$$

where y_{ijt} is a dummy variable equal to 1, if respondent i selected alternative j in choice situation t, and 0 otherwise. Maximizing the simulated log-likelihood function in equation (3) allows deriving coefficient estimates, while the inverse of the negative of the Hessian at convergence becomes the approximation of the asymptotic variance–covariance matrix, allowing for deriving the standard errors associated with model estimates.[1]

2.2. Risk preferences and loss aversion

To investigate individuals' loss aversion and risk preferences we use sets of two-outcome lotteries in the financial domain. We assume that the utility function for a two-outcome gamble takes the following form:

$$V(x, p; y, q) = \begin{cases} w(p)v(x) + [1 - w(p)]v(y) & \text{if } x > y > 0 \text{ or } x < y < 0 \\ w(p)v(x) + w(q)v(y) & \text{if } x < 0 < y \end{cases} \tag{4}$$

where $v(x)$ and $v(y)$ are value functions, $w(p)$ and $w(q)$ are probability weighting functions, x and y are the outcomes, and p and q are probabilities associated with those outcomes (and p + q = 1).

The value function considered in this application is:

[1] The model was estimated using a DCE package developed in Matlab and available at

https://github.com/czaj/DCE. The code and data for estimating the model presented here, as well as additional results, are available from http://czaj.org/research/supplementary-materials.

$$
';:(y) = 1 \quad y^{\square} \;\; \text{II } y \geq 0 \qquad (5)
$$
$$
-I(-y)^{\square} \;\; \text{II } y < 0
$$

where x is an outcome, □ represents risk preferences (curvature of the value function), and □ is the degree of loss aversion. If an individual is risk loving then □ >1; if risk neutral, then □ = 1; and if risk averse, then 0 <□ <1. However, □ can take only positive values. It measures one's sensitivity to loss compared to gain. The higher the value of □, the more loss averse an individual is.

In PT, gains and losses are compared to a reference point (the current position) and can accommodate different weightings – specifically, losses can be weighted more heavily than equivalent gains. Following Tanaka et al. 2010, we assume a nonlinear probability weighting measure (see Prelec, 1998). In this case, the probability weighting function is written as follows[2]:

$$
1(I) = 1yI[-(-1l\, I)^{n}] \qquad (6)
$$

where p is the probability of the outcome x, and □ is the probability sensitivity parameter. If □

< 1, the weighting function takes an inverted S-shape; that is, individuals overweight small probabilities and underweight large probabilities (Tversky and Kahneman, 1992). Hence, these individuals are probabilistic risk averse for low-likelihood losses and high-likelihood gains and conversely probabilistic risk seeking for low-likelihood gains and high-likelihood losses.

[2] This process of transforming the probabilities into decision weights breaks the independence axiom; that is, probabilities and outcomes are independent (Starmer, 2000).

3. Survey

3.1. Survey, data collection and sample

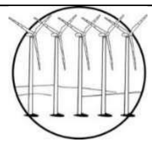
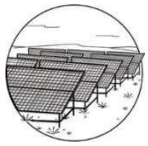
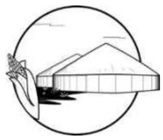
The survey consisted of five main sections. In the first section the respondents were informed that renewable energies as well as the electricity grid would be expanded in Poland. Additionally, this section provided respondents with general information concerning wind, solar, and biomass energy and collected information about respondents' exposure to renewable energy production sites and their general attitude towards them. Pictures and graphical illustration supported the text. Section 2 presented the choice tasks. For each task, respondents were asked to choose their preferred option from among several alternatives regarding the development of renewable energy production sites within 10 km of their place of residence. The choice sets, which were presented in a randomized order, contained both increases and decreases in the monthly energy bill the household has to pay, according to the experimental design (see Section 3.2). In section 4, individuals' financial risk preferences were elicited by using MPL, which was prefaced with the instructions adapted from Tanaka et al. (2010) that explained the task mechanism, and further attitudinal statements were presented to respondents. Socio-demographic variables were requested in the last section.

The survey took place in January 2016. The sample is representative of the Polish population in terms of age, gender, the size of the community, and geographical location. In total, 800 face-to-face interviews were conducted using the computer-assisted personal interviewing (CAPI) system by a professional polling agency. The questionnaire and the lottery task were tested for understandability with students from the Faculty of Economic Sciences at the University of Warsaw and people from the general public. Additionally, the discrete choice part of the survey was tested earlier in a survey in Germany (EnergyEFFAR project; see Oehlmann und Meyerhoff, 2016).

3.2. Choice attributes and experimental design

We adapted the CE designed for the project EnergyEFFAR.[3] The CE comprises four labeled alternatives. The first three refer to the development of wind, solar, and biomass energy sites within 10 km of a respondent's place of residence. The fourth alternative (future status quo, FSQ) indicates that respondents agree to not have an influence on the renewable energy extension in their neighborhood, and the attribute levels presented in this option were acceptable to them (see also Figure 1). The CE was introduced to the respondents in a following way: "Renewable energies as well as the electricity grid will be expanded in Poland. On the following choice sets, you can choose among different alternatives of renewable energy development. Please think of renewable energy production sites to be built in the 10 km surroundings of your place of residence. If you live in a large city, please consider the surrounding area of your city." In order to facilitate understanding of alternatives' descriptions we applied pictograms presented in Table 1.

Table 1
Renewable energy: definitions and pictograms

Type	Definition	Pictogram
Wind energy	Electricity generation with single wind turbines and wind farms exclusively onshore	
Solar energy	Electricity generation with photovoltaic system in the open landscape	
Biomass	Electricity generation with biogas and biomass from the cultivation of, for example, corn	

[3] The CE design in both Polish and German studies is the same apart from the adaption of cost levels to the Polish conditions (we used the nominal exchange rate from 2015 with the PPP adjustment). We purposefully aimed to have similar designs in both countries to enable to conduct a benefit transfer investigation, which is the subject of another study.

In the CE we used four attributes related to renewable energy landscape externalities and a monetary attribute. The monetary attribute took the form of increase or decrease in respondents' current energy bills. The choice of FSQ resulted in no increases in energy bills. Table 2 shows the full list of attributes and their levels used in the experimental design.

Table 2

CE attributes and levels

Attribute	Attribute label	Attribute level
Minimum distance to residential areas	Distance	300 m, 600 m, 900 m (FSQ), 1600 m, 2500 m
Size of renewable energy production sites	REPS size	Small, medium (FSQ), large*
Number of renewable energy production sites	REPS number	1, 2, 3 (FSQ), 4, 5
Share of landscape not used for renewable energy expansion**	Landscape	10%, 20%, 30% (FSQ), 40%, 50%
High-voltage transmission lines	HVTL	Overhead (FSQ), underground
Monthly change in energy bill (annually)	Cost	−20 zł (−240 zł), −10 zł (−120 zł), 0zł (FSQ), +5 zł (+60 zł), +15 zł (+180zł), +30 zł (+360 zł), +50 zł (+600 zł)**

* For the wind energy alternative, small was defined as 5–10 turbines, medium as 18–25 turbines, and large as 35–50 turbines. In the case of the solar energy alternative, 0.5–5 hectares, 20–40 hectares, and 60–100 hectares indicated small, medium, and large, respectively. For the biomass energy alternative, small meant 1–3 fermentation tanks; medium, 5–8 fermentation tanks; and large, 15–25 fermentation tanks.

** This attribute relates to the adjunct share of the landscape in the 10 km surroundings which will not be used for renewable energy development in the future.

***Nominal exchange rate in January 2016: 1 Euro = 4.36 zł, PPP zł/Euro in 2016 =2.346 (OECD, 2017)

The choice sets were created using a Bayesian efficient design using the NGene software, and the C-error optimization criterion was applied (Scarpa and Rose, 2008). The final design comprised 24 choice sets that were blocked into four subsets, each with six choice sets. The order of choice sets was randomized as was the order of the first three labelled alternatives. We ensured that each choice set and each alternative was presented on every position a comparable number of times. An example choice card set is presented in Figure 1.

	Electricity from wind	Electricity from biomass	Electricity from solar	"Do not care"
Minimum distance to residential areas	600 m	2500 m	300 m	900 m
Size of renewable energy production sites	Large (35–50 turbines)	Large (15–25 fermentation tanks)	Small (0.5–5 hectares)	Medium
Number of renewable energy production sites	4	5	5	3
Share of landscape not used for renewable energy expansion	20%	50%	10%	30%
High-voltage transmission lines	Underground	underground	overhead	overhead
Monthly change in energy bill (annually)	+30zł (+360zł)	−10zł (−120zł)	+30 (+360zł)	0 zł
Choice	□	□	□	□

Fig. 1. Example of a choice set

3.3. Financial lotteries

Respondents were presented with three series of lottery pairs and asked to choose one lottery for each pair. Moving down the list of lotteries, payoffs in Option B increase, but everything else is fixed. The lotteries are designed so that any combination of choices in the three series determines an individual's risk preferences and loss aversion (see Table 3).

Table 3

Three series of pairwise lottery choices for the financial outcome domain

Series 1								
Option A				Option B				EV(A)-EV(B)
Prob.	Payoff	Prob.	Payoff	Prob.	Payoff	Prob.	Payoff	
0.3	400 zł	0.7	100 zł	0.1	680 zł	0.9	50 zł	77 zł
0.3	400 zł	0.7	100 zł	0.1	750 zł	0.9	50 zł	70 zł
0.3	400 zł	0.7	100 zł	0.1	830 zł	0.9	50 zł	62 zł
0.3	400 zł	0.7	100 zł	0.1	930 zł	0.9	50 zł	52 zł
0.3	400 zł	0.7	100 zł	0.1	1060 zł	0.9	50 zł	39 zł
0.3	400 zł	0.7	100 zł	0.1	1250 zł	0.9	50 zł	20 zł

0.3	400 zł	0.7	100 zł	0.1	1500 zł	0.9	50 zł	−5 zł
0.3	400 zł	0.7	100 zł	0.1	1850 zł	0.9	50 zł	−40 zł
0.3	400 zł	0.7	100 zł	0.1	2200 zł	0.9	50 zł	−75 zł
0.3	400 zł	0.7	100 zł	0.1	3000 zł	0.9	50 zł	−155 zł
0.3	400 zł	0.7	100 zł	0.1	4000 zł	0.9	50 zł	−255 zł
0.3	400 zł	0.7	100 zł	0.1	6000 zł	0.9	50 zł	−455 zł
0.3	400 zł	0.7	100 zł	0.1	10,000 zł	0.9	50 zł	−855 zł
0.3	400 zł	0.7	100 zł	0.1	17,000 zł	0.9	50 zł	−1,555 zł

Series 2

Option A				Option B				EV(A)-EV(B)
Prob.	Payoff	Prob.	Payoff	Prob.	Payoff	Prob.	Payoff	
0.9	400 zł	0.1	300 zł	0.7	540 zł	0.3	50 zł	−3 zł
0.9	400 zł	0.1	300 zł	0.7	560 zł	0.3	50 zł	−17 zł
0.9	400 zł	0.1	300 zł	0.7	580 zł	0.3	50 zł	−31 zł
0.9	400 zł	0.1	300 zł	0.7	600 zł	0.3	50 zł	−45 zł
0.9	400 zł	0.1	300 zł	0.7	620 zł	0.3	50 zł	−59 zł
0.9	400 zł	0.1	300 zł	0.7	650 zł	0.3	50 zł	−80 zł
0.9	400 zł	0.1	300 zł	0.7	680 zł	0.3	50 zł	−101 zł
0.9	400 zł	0.1	300 zł	0.7	720 zł	0.3	50 zł	−129 zł
0.9	400 zł	0.1	300 zł	0.7	770 zł	0.3	50 zł	−164 zł
0.9	400 zł	0.1	300 zł	0.7	830 zł	0.3	50 zł	−206 zł
0.9	400 zł	0.1	300 zł	0.7	900 zł	0.3	50 zł	−255 zł
0.9	400 zł	0.1	300 zł	0.7	1000 zł	0.3	50 zł	−325 zł
0.9	400 zł	0.1	300 zł	0.7	1100 zł	0.3	50 zł	−395 zł
0.9	400 zł	0.1	300 zł	0.7	1300 zł	0.3	50 zł	−535 zł

Series 3

Option A				Option B				EV(A)-EV(B)
Prob.	Payoffs	Prob.	Payoffs	Prob.	Payoffs	Prob.	Payoffs	
0.5	250 zł	0.5	−40 zł	0.5	300 zł	0.5	−210 zł	60 zł
0.5	40 zł	0.5	−40 zł	0.5	300 zł	0.5	−210 zł	−45 zł
0.5	10 zł	0.5	−40 zł	0.5	300 zł	0.5	−210 zł	−60 zł
0.5	10 zł	0.5	−40 zł	0.5	300 zł	0.5	−160 zł	−85 zł
0.5	10 zł	0.5	−80 zł	0.5	300 zł	0.5	−160 zł	−105 zł
0.5	10 zł	0.5	−80 zł	0.5	300 zł	0.5	−140 zł	−115 zł
0.5	10 zł	0.5	−80 zł	0.5	300 zł	0.5	−110 zł	−130 zł

The switching points in Series 1 and 2 jointly determine the risk preference parameter □. In Series 1, if an individual switches from Option A in row N, it means that he or she prefers

Option A over Option B at N − 1 rows and prefers Option B over Option A in row N (and following rows).[4] The same approach is used in Series 2 (rows notation K − 1 and K). To determine the value ranges for both parameters the following inequalities should be satisfied:

$$\text{L.}\,1y_{II,l,III}n^{□}\,lyI[-(-\,ll1I_{II,III}n)^{n}] + 1Y_{I,III}n^{□}\{1 - lyI[-(-\,ll1I_{II,III}n)^{n}]\} > 1y_{II,I,III}n^{□}\,lyI[-(-ll11_{II,III}n)^{n} + 1Y_{II,l,III}n^{□}\{1 - lyI[-(-\,ll11_{II,III}n)^{n}]\}$$

$$1y_{II,I,I}\,n^{□}\,lyI[-(-\,ll1I_{II,I}n)^{n}] + 1Y_{l,I}n^{□}\{1 - lyI[-(-\,ll1I_{II,I}n)^{n}]\} > 1y_{II,l,I}\,n^{□}\,lyI[-(-\,ll11_{II,I}n)^{n} + 1Y_{II,I,I}n^{□}\{1 - lyI[-(-\,ll11_{II,I}n)^{n}]\} \qquad (4)$$

$$□\,1y_{II,l,III}n^{□}\,lyI[-(-\,ll1I_{II,III}n)^{n}] + 1Y_{I,III}n^{□}\{1 - lyI[-(-\,ll1I_{II,III}n)^{n}]\} > 1y_{II,I,III}n\,lyI[-(-ll11_{II,III}n)^{n} + 1Y_{II,l,III}n\,\{1 - lyI[-(-\,ll11_{II,III}n)^{n}]\}$$

$$1y_{II,I,I}n^{□}\,lyI[-(-ll1I_{II,I}n)^{n}] + 1Y_{l,I}n^{□}\{1 - lyI[-(-ll1I_{II,I}n)^{n}]\} > 1y_{II,l,I}n^{□}\,lyI[-(-ll11_{II,I}n)^{n} + 1Y_{II,I,I}n^{□}\{1 - lyI[-(-ll11_{II,I}n)^{n}]\}$$

where x and y are outcomes, p is the probability of the outcome x, □ is the probability weighting parameter, N and K denote the number of rows, A and B indicate the lottery options, and S1 and S2 denote Series 1 and Series 2, respectively. The parameter □ is not uniquely determinable. Here, we follow Tanaka et al. (2010) and their convention of approximating □ by taking the midpoint of the interval. The loss aversion parameter can be determined by the switching points in Series 3 after obtaining an estimate of □ and □ based on choices in Series 1 and 2. Similar to□, the loss aversion parameter □ can also be estimated as the midpoint of an interval; a higher

□represents a higher degree of loss aversion.

[4] Similar to Tanaka et al. (2010), we tried to enforce monotonic switching by asking respondents to indicate at which row they would switch from Option A to Option B in each series, noting that they can also start to choose Option B with the first row. Those who insisted on switching back, however, were allowed to do so.

4. Results

4.1. Descriptive statistics

Collected information regarding respondents' experience with renewable energy production sites indicates that 91%, 57%, and 14% have encountered wind farms, solar, or biomass energy sites, respectively. Moreover, 33% of respondents stated that wind energy sites are within 10 km of their place of residence. For solar and biomass energy sites, this share equals 35% and 5%, respectively. Respondents considered biomass energy installations as the most disturbing form of renewable energy resources. In contrast, solar energy was perceived as the least burdensome. Results also show that the majority of respondents support the development of renewable energy in Poland, while a notable minority (12%) advocates for conventional energy. The development of nuclear energy was supported by 8%. Table 4 reports the basic socio-demographic characteristic of the sample.

Table 4
Descriptive statistics of the sample characteristics.

	Share	Mean	Median	Min	Max
Women	53%				
Age		49	50	19	86
Education					
- Primary	37%				
- Secondary	35%				
- High	28%				
Net monthly individual income in zł		1965	1500	500	15000

Note: Number of respondents, N = 744.

4.2. Risk preference and loss aversion parameters

Table 5 presents the statistics of risk preferences and loss aversion across the sample. Risk-averse and risk-neutral individuals constituted 62% of the respondents. The average estimated value of loss aversion parameter is significantly different from 1 (t-test, p = 0.001), indicating that individuals weighted losses more heavily than equivalent gains. In terms of the CE analysis to be reported, the risk preference parameter □ and the loss aversion parameter □ for each respondent enter via an interaction effect with the monetary attribute, separately for rebates and surcharges.

Table 5

Risk preference and loss aversion in the analyzed sample

Risk preference and loss aversion parameters	Mean	St. dev.	Median
□	0.81	0.48	0.85
□	2.61	3.64	1.11

4.3. Model results bringing together CE and MPL responses

Table 6 presents the results of the MXL model used to estimate parameters of our respondents' utility functions. The estimated coefficients reflect marginal utilities associated with changes in the levels of the attributes, and as a result, changes in the probability of selecting an alternative. The monetary attribute was transformed into two variables, one including all negative levels (i.e., decreases in the energy bill) and the other including all positive levels (i.e., increases in the energy bill). This way we can estimate separate coefficients representing the marginal utility of budget decrease or increase, resulting from changes in the energy bill of the household.

Consumers' preference heterogeneity is incorporated into the model by making the utility function parameters random according to a priori selected parametric distributions. For each attribute we report the estimate of the mean and standard deviation of its parameter distribution in the population. Although the coefficients do not have direct interpretation, their signs reflect whether more of a particular attribute is perceived as good or bad, while their relative values indicate their relative importance.

Table 6

Estimation results

Variable	Distribution	Means (s.e.)	Standard deviations(s.e.)
ASC_wind energy	Normal	2.7250*** (0.3637)	5.2560*** (0.4184)
ASC_biomass energy	Normal	1.4557*** (0.3717)	4.7420*** (0.4273)
ASC_solar energy	Normal	4.8052*** (0.3802)	5.6042*** (0.4089)
Distance	Normal	0.3861*** (0.0629)	0.6206*** (0.0881)
REPS size	Normal	-0.0349 (0.0854)	0.4307*** (0.0948)
REPS number	Normal	-0.0775* (0.0466)	0.2437*** (0.0630)
Landscape	Normal	0.5860* (0.3433)	2.3734*** (0.6671)
HVTL	Normal	0.2175** (0.1024)	1.0987*** (0.3786)
Rebate per month (income increase) in Euro	Lognormal †	-5.4470*** (1.1679)	3.3359*** (0.6163)
x □ (loss aversion)		-0.9641*** (0.3503)	
x □ (risk preferences)		0.5293* (0.2723)	
Surcharge per month (income decrease) in Euro	Lognormal	-1.5340*** (0.1538)	2.1267*** (0.1695)
x □ (loss aversion)		-0.0134 (0.1213)	
x □ (risk preferences)		-0.4726*** (0.1231)	
Model diagnostics			
LL at constants only		-3667.77	
LL at convergence		-5670.44	
McFadden's pseudo-R^2		0.3532	
Ben-Akiva-Lerman's pseudo-R^2		0.4749	
Number of observations		4,464	
Number of individuals		744	
Number of parameters		69	

† For lognormally distributed parameters the coefficients of the underlying normal distribution are reported.
***, **, * indicate 1%, 5%, 10% significance level, respectively.

Overall, the model is highly significant, and the signs of the parameters for nonmonetary attributes are generally as expected and also similar to the results found in the similar CE application in Germany (see Oehlmann and Meyerhoff, 2016). On average, the respondents would like to have an influence on the renewable energy extension in their neighborhood. The significance and signs of alternative-specific constants (ASCs) indicate that, all else held constant, the respondents prefer solar power over wind power and wind power over electricity from biogas in the 10 km surroundings of their place of residence.

Our results further indicate that people generally want REPS to be further from their place of residence as opposed to near. This finding aligns with what many other studies concerned with the externalities have found, especially for wind power (e.g., see Knapp and Ladenburg, 2015). With regard to the size of the REPS, the sign is negative but not statistically significant, suggesting that the size of the sites is not an important issue for respondents. The number of REPS influences the probability of choosing an option negatively. Similar results were obtained inter alia by Navrud et al., (2007) for wind turbines and hydroelectric power plants. Finally, the probability of choosing an alternative is significantly and positively influenced by the size of area in respondents' neighbourhood not used for renewable energy expansion and by building new high-voltage transmission lines underground. These findings are in line with results for example by Des Rosiers (2002) or Navrud et al. (2008). Relatively large and significant standard deviations in our model indicate the presence of substantial unobserved preference heterogeneity.

Turning to the main objectives of our analysis, we find both surcharge and rebate parameters to be statistically significant. While by assuming lognormal distributions we impose positive utility of money (income), the coefficients vary depending on whether respondent's income is increased or decreased.[5] The results indicate that, on average, marginal utility of money is lower with a money gain than with a money loss (cf. Faccioli et al., 2016).

Three parameters among the four interactions consisting of the two monetary variables and the risk aversion and loss aversion parameters are statistically significant. Loss aversion seems to play a role when people receive a rebate, while risk aversion matters both when people get a

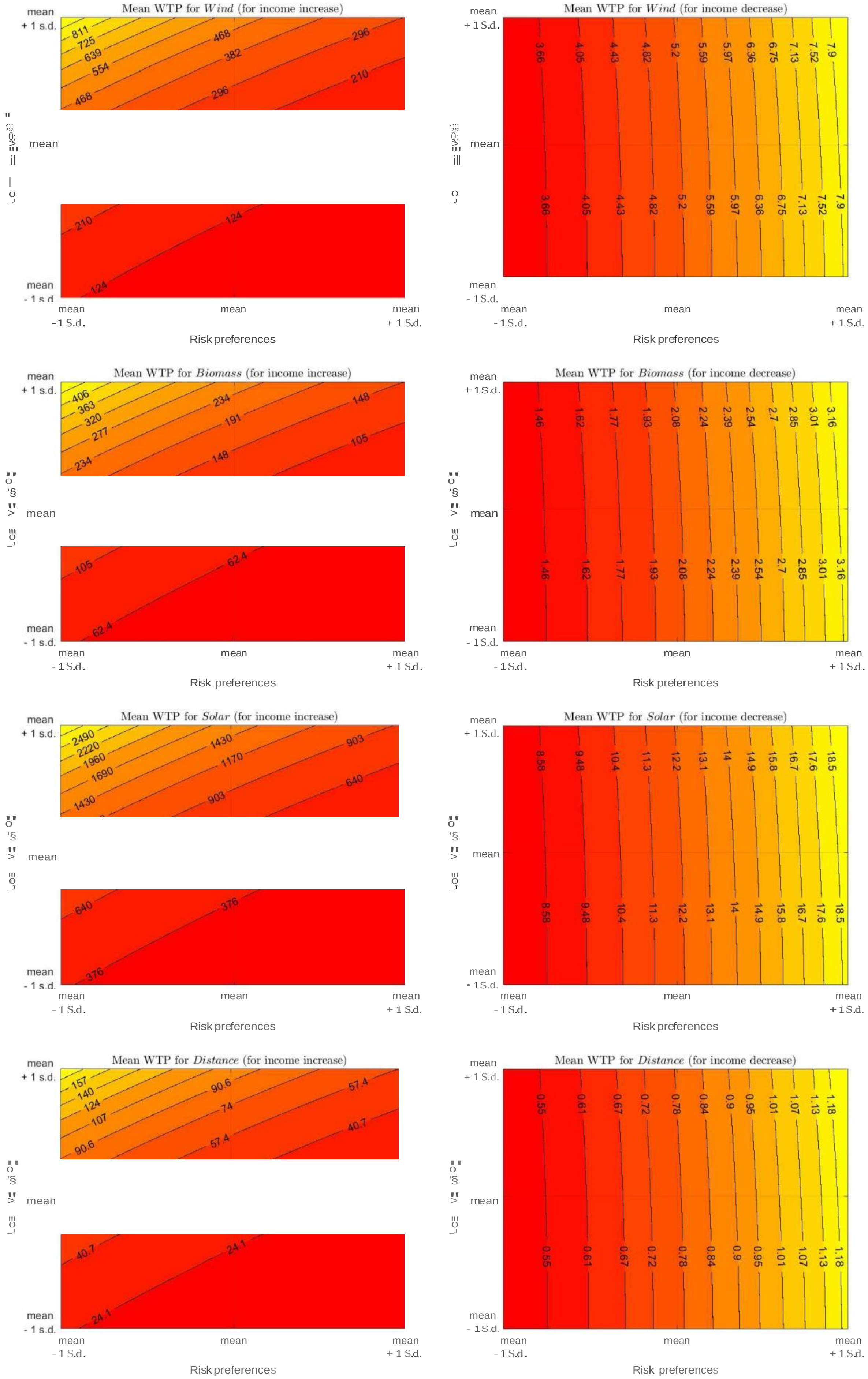
[5] Note that coefficients of lognormally distributed parameters in Table 3 refer to the underlying normal distribution; once these parameters are exponentiated they become strictly positive.

rebate and when they have to pay a surcharge for a chosen alternative. Starting with loss aversion, the parameter shows that the more loss averse respondents were in the lotteries, the higher the rebates they required (their marginal utility of income for income increase was lower) for accepting wind, solar, or biomass instead of status quo. Thus, people who are more loss averse require more compensation before they accept externalities from renewable electricity production. In the case of income decrease (increase of monthly charges) we did not observe significant effects of loss aversion.

The influence of risk preferences was significant for both, income increase and decrease. In the case of the former (rebate), more risk affine respondents were also more sensitive to money, and hence lower rebates were able to compensate them for the same attribute level changes. For income decrease (surcharge), respondents with higher risk preference had lower marginal utility of money, and hence required larger monetary amounts were needed to balance their utility levels in the case of other attribute level changes.

To illustrate the differences in preferences between respondents with different levels of risk and loss aversion, we simulated the mean WTP associated with our choice attributes for respondents with different levels of and λ. Because our model allows marginal utility of money to vary depending on whether alternatives in the choice sets present a surcharge or a rebate to an electricity bill, it is also possible to calculate WTP with respect to income increase or decrease. The results for significant main effects and labels are provided in Figure 2. The contour plots show how respondents' WTP changes if their loss aversion and risk parameters simultaneously vary from one standard deviation below the observed mean in the sample, through the sample mean, to one standard deviation above.

A clear pattern that emerges for these attributes is that WTP expressed with respect to income increase is much more sensitive to changes in respondents' loss aversion, while WTP expressed with respect to income decrease is more sensitive to changes in respondents' risk preferences. This way we provide an intuitive illustration for the results presented in Table 6, across a wide range of values of □ and □ parameters observed in the sample.


Mean WTP for Wind (for income increase)
Mean WTP for Wind (for income decrease)
Mean WTP for Biomass (for income increase)
Mean WTP for Biomass (for income decrease)
Mean WTP for Solar (for income increase)
Mean WTP for Solar (for income decrease)
Mean WTP for Distance (for income increase)
Mean WTP for Distance (for income decrease)
mean + 1 s.d.
mean
mean - 1 s.d.
Risk preferences

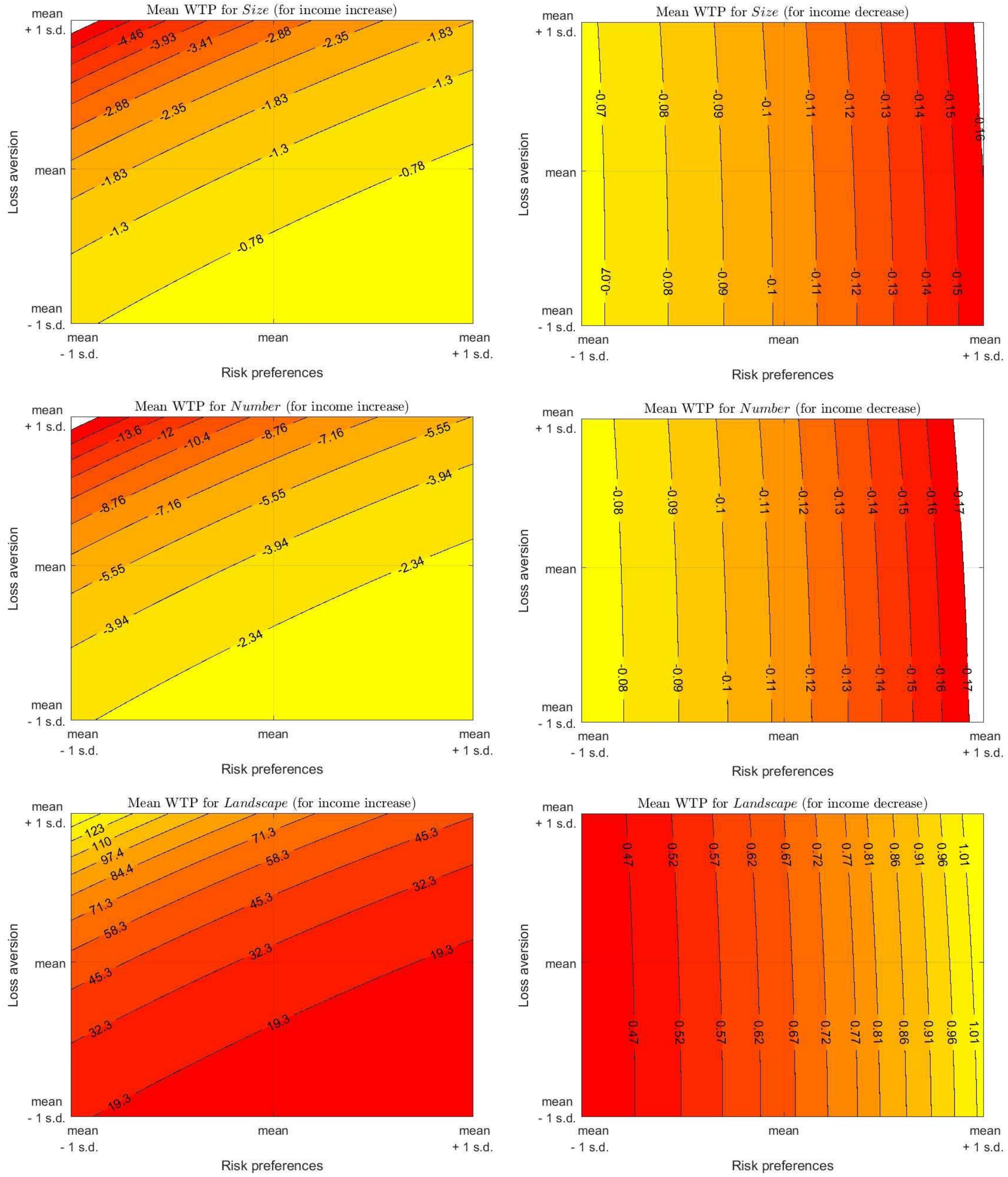


Fig. 2. WTP for changes in removable energy development simulated for money gain and loss for respondents with different loss aversion and risk preferences.

5. Conclusions

In this paper we examine the impact of the direction of price changes on the valuation of avoiding renewable energy externalities in Poland and investigate whether the potential asymmetry in respondents to price increases and decreases is driven by financial loss aversion and risk preferences – the key elements of prospect theory. Analyzing data from a large sample of the Polish population, we find that marginal utility of money seems to be lower with a rebate on the energy bill than with a surcharge to avoid. This result adds to the literature suggesting that people care about the mechanisms by which the funds for public projects are raised (e.g., see Ozdemir et al., 2016, Aravena et al., 2014, or Wlezien, 2004).

As far as we know, this study is the first to investigate the effects of financial loss aversion and risk preferences on the acceptance of price decreases or increases in a CE. Our findings indicate that financial risk preferences affect people's choices both in the case of a surcharge and in the case of a rebate while loss aversion for money affects them only when people receive a rebate. These results are in line with Novemsky and Kahneman (2005) and Weber et al. (2007), who argue that loss aversion in money is not present during a buying process. Surprisingly, however, we find that financial loss aversion seems to play a role in a selling process (accepting the price decrease). In the context of our study, this observation can be connected with potential uncertainty concerning the total effects of renewable energy development.

We find that the more risk seeking people are in a financial domain, the less cost sensitive they are and the more they are willing to pay for proposed changes in renewable energy development. At the same time people who are more risk averse require less compensation before they accept externalities from renewable electricity production. With respect to the loss aversion, the more loss averse people are with regard to money, the more compensation they require before they accept externalities from renewable electricity production. Intuitively, these findings make sense. People are assumed to be risk averse with respect to small decrements from current wealth, which would occur in the context of a surcharge, and this aversion would be expected to increase as their uncertainty about the impact on their utility grew, resulting in a lower WTP the more risk averse an individual is. Likewise, the more loss averse an individual is, the higher the rebate required for them to prefer the alternative over the FSQ. Additionally, the more financially risk averse a person is the higher rebate they require for accepting renewable energy externalities.

More research is needed to investigate the generalizability of these results. In the case of loss aversion, our interpretation relies on the assumption that the FSQ is respondents' reference point, as opposed to another (unobserved) scenario. Nevertheless, our results have implications for the value of nonmarket goods and services since they imply that this value changes depending on how people are required to fund the goods and services and how they are valued in a SP study. We have provided one potential cause, but there may well be other significant factors that also influence choices that could be investigated in the future, while controlling for the observed impact of risk preferences and loss aversion. Referring to the article by Aravena et al. (2014), we finally conclude that money seems to talk in certain circumstances, although we would prefer it to be silent because it can significantly influence the value of environmental changes.

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